



Docket No.: CMI-001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Group Art Unit: 1771

Examiner: Piziali

Serial No.: 10/813,703

Filed: Nov. 3, 2004

In re Application of: Douglass

For: Fiber Insulation Blanket and Method of Manufacture

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### DECLARATION OF DAVID W. YARBROUGH

I, David W. Yarbrough, declare as follows:

1. I have been retained by Earl Stuart Douglass and his Counsel to serve as an expert in the field of thermal insulation. Exhibit A is a copy of my resume that recites my technical experience and qualifications.

#### **I. Qualifications**

2. I received a BChE (with honors) Georgia Institute of Technology in 1960. I received a M.S. in Chemical Engineering in 1961, and a Ph.D. in Chemical Engineering in 1966, both from Georgia Institute of Technology
3. I am presently Professor of Chemical Engineering, Emeritus, Tennessee Technological University. I retired as Chairman and Professor of Chemical Engineering in 2002.
4. I am the author or co-author of numerous publications related to thermal insulation. My publications and presentations are listed in my resume.
5. I am presently President of R&D Services, Inc., a NVLAP accredited testing and consulting company specializing in thermal insulation.
6. I am a registered Professional Engineer in the states of Tennessee and Florida.
7. I have been asked to address the Examiner's comments made in rejecting the subject application.
8. I have reviewed the subject application, the Examiner's comments, and the Kean reference, U.S. Patent Number 5,491,186.

#### **II. Opinion Regarding The Examiner's Statements/Questions.**

9. In the Examiner's Office Action, the Examiner stated that the composition of the Kean patent inherently results in an R-value of greater than 4 as claimed in the subject application.
10. I respectfully disagree with this conclusion for the following reasons.

11. I have been informed by patent counsel that to maintain a rejection based upon inherency, the Examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied reference.
12. By law, R-value is a measured property for residential applications. Thermal resistivity,  $R^*$ , or R-value per inch of thickness, is a material property of thermal insulations that is determined using a consensus test method such as ASTM C 518.
13. A priori evaluations of the thermal resistivity of a cellulosic insulation based on fiber dimensions and chemical content are not practiced in the art. Accordingly, it is my opinion that the Examiner's estimation of thermal insulation properties of the Keane reference is incorrect as against the teachings and standards practiced in the thermal insulation field.
14. Heat transfer through fibrous insulations including batt-type cellulosic materials occurs by radiation, convection, solid-phase conduction, and gas-phase conduction. In the case of cellulose batts with densities above about  $30 \text{ kg/m}^3$ , natural convection is negligible. The gas phase in the case of cellulosic batts is air which is a well-characterized material. The contribution of gas-phase conduction to the overall heat transfer can be calculated with confidence. This component makes up about 50% of the total heat transfer.
15. The radiative contribution to the total heat transfer depends in a very complex way on absorption, scattering, and transmission of radiant energy. The physical property information needed to undertake a calculation of radiative transfer through cellulose insulation is not available. The determination of this type of material property information is a subject of on-going research. In addition to the lack of basic data for radiative transport, the geometrical arrangement of fibers in a cellulose batt is complex making a direct calculation of the radiative transport untenable at this time. Radiation transport makes up 35 to 45 % of the total heat flow through a cellulose batt.
16. Heat flow through the solid phase consisting of cellulose fibers, adhesives, and chemical fire retardants makes up the remaining relatively small contribution to the total heat flow. The solid-phase heat flow depends on the thermal conductivity of the materials present and their geometrical arrangement. The physical contact between fibers is obviously an issue. The quantity of solid material present in a cellulose insulation is a factor that is conventionally characterized by a bulk density. The physical property data for the components is known approximately, but the physical arrangement of fibers tends to be random and not well characterized. This component of heat transfer can not be calculated with confidence.
17. All of the properties that have been listed vary with temperature. Thermal insulation intended for use in building as conventionally labeled at an average operating temperature of  $75^\circ\text{F}$ .
18. The thermal performance of a given insulation at fixed temperature is taken to be a function of density and described by the following equation:

$$k_a = a + b \cdot \rho + c/\rho$$

$k_a$  is the apparent thermal conductivity

$\rho$  is the density

a, b, and c are material specific, temperature dependent constants that are normally determined by applying the Method of Least Squares to a set of measurements  $\{ \rho, k_a \}$ .

19. The thermal resistivity,  $R^*$ , is the reciprocal of the apparent thermal conductivity.

$$R^* = 1/(a + b \cdot \rho + c/\rho) = 1/k_a$$

20. Code bodies and federal regulations dictate that thermal insulations be evaluated by consensus test methods such as those published by the American Society for Testing and Materials. A reliable calculation of thermal resistivity, thermal resistance, or apparent thermal conductivity from a physical description of the fibers requires data that are not available.
21. To further compound the problem, cellulose batts are compressible. A given collection of fibers can have a range of R-values that depends on the degree of compaction.
22. Accordingly, the idea that a casual description of a cellulosic insulation provides sufficient information to determine the material R-value with a reasonable level of confidence is incorrect.
23. In any event, fiber descriptions and composition are not sufficient for the determination of  $R^*$ .  $R^*$  of cellulosic insulation of specified composition depends on density, temperature, and water content. The latter two factors are addressed in the measurement standards. The density is a product design and application issue.
24. Thus, a specification of fiber content does not imply a level of thermal performance or  $R^*$  because a given collection of fibers can be arranged in a near-infinite number of ways each with a characteristic density.
25. The Keane patent makes no R-value claim, as the Examiner has noted in his remarks. Contrary to the Examiner's conclusion, any determination of the R-value of the composition of Keane would require that a specimen be produced and subjected to a thermal test as described above.
26. For these reasons, it is my opinion that a given R-value can not be described as inherently resulting from the description of the Keane patent. 12.
27. I recommend, therefore, that the Examiner withdraw the rejection to the subject application that are related to the inherency issue discussed above.

28. I declare that all of my statements concerning knowledge and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements are punishable by fine or imprisonment, or both under 18 U.S.C. §1001, and that willful false statements may jeopardize the validity of the patent.

Dated: November 27, 2006

A handwritten signature in black ink, reading "David W. Yarbrough". The signature is written in a cursive style with a large, looping 'D' and 'Y'.

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David W. Yarbrough, PhD, PE

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## BIOGRAPHICAL SKETCH

**YARBROUGH, DAVID W. - President, R&D Services, Inc.  
Cookeville, Tennessee**

**November 14, 2005**

<b>Education:</b>	Ph.D. (Ch.E.) Georgia Institute of Technology (Ford Foundation Fellow)	1966
	M.S. (Ch.E.) Georgia Institute of Technology	1961
	BChE (with Honor) Georgia Institute of Technology	1960
 <b>Professional Registration:</b>		
	Professional Engineer (P.E.), Tennessee No. 14899 Florida No. 050595	
 <b>Experience:</b>	President, R & D Services, Inc.	1994-
Present	Chairman and Professor of Chemical Engineering, TTU	1987-2001
	Professor Emeritus, Tennessee Technological University	2002-
	Professor of Chemical Engineering, TTU	1980-1987
	Research Staff, Oak Ridge National Laboratory (part time)	1980-Present
	Research Staff Member, ORNL (full time)	1979-1980
	Associate Dean of Engineering for Graduate Studies and Research, Professor of Chemical Engineering, Tennessee Technological University	1976-1979
	Associate Professor of Chemical Engineering, TTU	1971-1976
	Assistant Professor of Chemical Engineering, TTU	1968-1971
	ILT, CPT U.S. Army, R & D Liaison Officer (retired 1987 LTC Signal Corp USAR)	1966-1968
	Chemical Engineer, Humble Oil Company, Houston	1966
	Graduate Teaching Assistant in Mathematics, Georgia Institute of Technology	1961-1966
	Faculty Research Participant, Savannah River Laboratory, Aiken, South Carolina	1981 Summer
Summer	Faculty Research Participant, Oak Ridge National Laboratory, Oak Ridge, Tennessee	1970
	Faculty Research Participant, Savannah River Laboratory, Aiken, South Carolina	1969 Summer
	Chemical Engineer, Ethyl Corporation, Baton Rouge, Louisiana	1961 Summer
	Junior Chemical Engineer, Humble Oil Co., Houston	1960
 <b>Consulting:</b>		
	Oak Ridge National Laboratory, Army Research Office, Gulf and Western Corp., Nu-Fuels Corp. Thermal Insulation Companies, State Energy Offices, Army Research Office, Reflective Insulation Manufacturers Association, Weyerhaeuser, Astro Packaging, Federal Trade Commission, Insurance Companies, Cellulose Insulation Manufacturers Association, Expert Witness work	
 <b>Societies:</b>		
	American Institute of Chemical Engineers – Member	1970-2002

**BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)**

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	American Society for Engineering Education - Member	
	Coordinator for the Middle Tennessee Branch	1974-1975
	American Society for Testing and Materials - Member	
	ASTM Committee C-16 (Member)	1979-
	Chairman Sub-Committee 16.21 Reflective Insulation	1985-1995
	Chairman Sub-Committee 16.24 Health and Safety	1998-2003
	Chairman Sub-Committee 16.92 Long-Range Planning	2003-
	Chairman Task Group - Precision and Bias	2003-
	Society of the Sigma Xi - Member	
	President of Tennessee Tech Club	1971-72, 1981-82
	Secretary	1982-2001
	International Council of Building Officials - Member	1987-1992
	International Assoc. of Science and Technology for Development	1985-1990
	The International Thermal Conductivity Conferences	1985-
	Governing Board Member	1985-
	Conference Steward	1993-
	Chairman for 19th ITCC	
	Tennessee Academy of Science - Executive Committee	1981-1989
	Engineering Section Chairman	1980-1984
	President-Elect	1985, President 1986
	New York Academy of Science	1986-1993
	Energy Conservation Society (Knoxville) - Charter Member, Steering Committee 1977-1980	
	Tau Beta Pi (Engineering, Ga Tech)	
	Phi Kappa Phi (Scholastic, Ga Tech)	
	Pi Mu Epsilon (Mathematics, Ga Tech)	
<b>Awards:</b>	Sigma Xi Research Award (TTU Club)	1983
	Fellow of the Tennessee Academy of Science	1986
	Fellow of the International Thermal Conductivity Conference	1987
	University Research Award (TTU)	1987
	Outstanding Faculty Award (TTU, College of Engineering)	1990
	International Thermal Conductivity Conferences - Fellow	1987
	Tennessee Academy of Science - Fellow	1986
	ASTM C 16 - Award of Appreciation	1992, 2000
	International Thermal Conductivity Conference Award	1995
	ASTM C 16 - Honors Award	1997
	Distinguished University Scientist, Tennessee Academy of Science	1998
<b>Biographical Listings:</b>		
	International Who's Who in Engineering, (1984)	
	Who's Who in Engineering	
	American Men and Women of Science, 15th Ed., (1982) 18th Ed., (1992)	
	Who's Who in the South and Southwest	
	International Directory of R & D Scientists	
	Who's Who in Technology Today, 3rd Ed., (1982), 4th Ed., (1984)	
	Who's Who in Chemistry and Plastics, 5th Edition	
<b>Special Assignments:</b>		
	Chairman, Thermal Science Research Group - TTU	1973-1976
	University Research Coordinator - TTU	1978
	Area Liaison - U.S. Military Academy - West Point	1975-1977
	Session Chairman for AIChE meeting on Energy Conservation	1984, Fall
	Adjunct Faculty Member, U.S. Army Command and	1983-1988

**BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)**

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General Staff College	
Session Chairman - World Congress III of Chemical Engineering, Tokyo	1986
Steering Committee for USDOE Project at Florida Solar Energy Center, Cape Canaveral	1986
Session Chairman - 2nd California Conference on Thermal Insulation	1989
Session Chairman - 21st International Thermal Conductivity Conference	1989
Session Chairman - International Thermal Insulation Conferences	1990-2004
Technical Session Chairman - 1991 Symposium on Insulation Materials - ASTM - Gatlinburg, TN, October 10-12	1991
Associate Editor, Journal of Thermal Insulation and Building Envelopes	1992-
Session Chairman - Cairo 5th International Conference	1996
Session Chairman - International Thermal Conductivity Conference	1997, 2001, 2005

**Invited Lectures:**

Universidad Nacional Autonoma De Mexico	1973
Instituto Politecnico Nacional (Mexico)	1973
Universidad Autonoma De Guadalajara	1973, 1974
"Insulation Materials R & D," Applegate Insulation Systems Meeting, Louisville, KY, (5/21/83)	1983
"The Development of Improved Thermal Insulations and Measurement Techniques," William Maxwell Reed Engineering Seminar, University of Kentucky, Lexington, Kentucky, (November 15, 1984).	1984
"Radiant Heat Barrier Theory and Practice," Energy Update Seminar, Georgia Institute of Technology, Atlanta, GA (April 16, 1987).	1987
"Factors that Affect the Aging of Foam Insulations" Seminar, Vanderbilt University (January 15, 1993)	1993
"Heat Transfer in Insulation", "Expectations of Future Engineers" First International Congress for Engineering Students U. of Honduras, Tegucigalpa, Honduras	1998

**Research Interests:**

Chemical Thermodynamics, Materials for Energy Conservation, Numerical Modeling, Heat Transfer, Thermal Insulation

**Reviewer:**

AIChE Journal, ASTM, ASHRAE, Rev. of Sci. Inst., Journal of Thermal Insulation and Building Envelopes, Chemical Engineering Communications, NASA, USDOE, ITCC

**Publications and Presentations:**

**2005**

"Analysis of Scaling Data for Long-Term Thermal Resistance of Closed-Cell Foams", Proc. of the International Conference on Thermal Insulation, Volume 20, 204-216 (2005).

"Measured R-Values of Thermal Insulations Produced from Loose-Fill Material with a Foamable Adhesive", *Thermal Conductivity 27* pages 196-206, DEStech Publications, Inc., Lancaster, PA (2005) with Y. C. Kwon.

"Apparent Thermal Conductivity Data and Related Information for Rice Hulls and Crushed Pecan Shells", *Thermal Conductivity 27* pages 222-230, DEStech Publications, Inc., Lancaster, PA (2005) with K. E. Wilkes, P. A. Olivier, R. S. Graves and A. Vohra.

"Apparent Thermal Conductivity of Sand", *Thermal Conductivity 27* pages 250-259, DEStech Publications, Inc., Lancaster, PA. (2005) with K. Manohar and K. Ramroop.

"The Long-Term Thermal Resistance of Foams having Non-Uniform Density", 28<sup>th</sup> International Thermal Conductivity Conference, St. Andrews-by-the-Sea, New Brunswick, Canada (2005) with Phaneendra B. Kondapi and J. Richard Booth.

"Radiative Transfer Across Sugarcane and Coconut Fiber", 28<sup>th</sup> International Thermal Conductivity Conference, St. Andrews-by-the-Sea, New Brunswick, Canada (2005) with Krishpersad Manohar and Dale Ramlakhan.

**2004**

"Thermal Conductivity of Trinidad Wood", Proc. of the International Conference on Thermal Insulation, Volume 19, 103-112 (2004) with K. Manohar, D. Ramlakhan, and G. S. Kochhar.

"Thermal Performance of Reflective Insulation Used on Air-Handling Ducts", Proc. of the International Conference on Thermal Insulation, Volume 19, pages 113-126 (2004).

"The International Conferences on Fire Safety, Thermal Insulation, and Electrical and Electronic Products", Proc. of the International Conference on Thermal Insulation, Volume 19, pages 189-199 (2004) with C. J. Hilado.

"Long-Term Thermal Resistance of Cellular Plastic Insulations", J. of the Tennessee Academy of Science 80 40 (2005) abstract

**2003**



“A Comparison of Biodegradable Fiber Insulation with Conventional Insulation”, Proc. of the International Conference on Thermal Insulation” Volume 18, pages 133-140 (2003) with K. Manohar.

“Thermal Resistivities of Spray-Applied Insulations Produced with a Foamable Adhesive”, Proc. of the International Conference on Thermal Insulation, Volume 18, pages 170-181 (2003).

## **2002**

“Use of a Heat-Flow-Meter Apparatus to Evaluate Reflective Insulation Systems”, Proc. of the International Conference on Thermal Insulation, Volume 16, 89-109 (2002) (with P. Kanade).

“Review of Thermal Properties of a Variety of Commercial and Industrial Pipe Insulation Materials”, ASTM STP 1426 (2002) pp. 284-295 with Thomas E. Whitaker.

## **2001**

“Properties of Cementitious Composites Containing Recycleable Plastic Fine Aggregate,” Proceedings of the 2001 Virginia Tech Green Engineering Conference, (2001) (with I. Shehate, A. ElSawy, and N. Ghafoor).

“Industrial Insulation for Savings and Safety,” Proceedings of the Fourteenth International Conference on Thermal Insulation, pp. 118-131, White Sulphur Springs, WVA, January 8-10, 2001.

“The International Conferences on Fire Safety, Thermal Insulation, and Electrical and Electronic Products,” Proceedings of the Fourteenth International Conference on Thermal Insulation, pp. 132-140, White Sulphur Springs, WVA, January 8-10, 2001.

## **2000**

“Effective Diffusivity of HCFC-141b, HFC-134a, HFC-245fa, and Cyclopentane in PIR Foam by Thin-Slice Gravimetric Analysis,” Polyurethanes 2000, October 8-11, 2000, Boston, MA (with J. Richard Booth, Kenneth E. Wilkes, and W. Alex Gabbard).

“Energy and Global Warming Impacts of Building Foam Insulation: TEWI Phase 3,” ORNL/TM-2000/246, Oak Ridge National Laboratory, Oak Ridge, TN, July 2000 (with Jan Kosny, Gavin, and Andre Desjarlais).

“Measurement of Apparent Thermal Conductivity by the Thermal Probe Method,” Journal of Testing and Evaluation, **28** (5) pp. 345-351 (2000) (with K. Manohar and J. R. Booth).

## **1999**

“Energy Efficiency Study of Single-Wide Manufactured Homes,” Oak Ridge National Laboratory, Oak Ridge, TN, C/ORNL/93-0191 (December 1999) (with Gregory J. Andrews, Therese K. Stovall, and Ty Kelly).

“Review of Cellulose Insulation Fire Safety,” Twenty-Seventh International Conference on Fire Safety, Millbrae, CA, January 11-15, 1999.

Dariusz

"Transient Gas Diffusion in Closed-Cell Foam Using an Implicit Finite Difference Method," Thermal Conductivity 24, Editors: Peter S. Gaal and Daniela E. Apostolescu, Technomic Publishing Company (1999) pp. 428-436 (with P. B. Kondapi and J. R. Booth).

"The Effect of Compression on the Apparent Thermal Conductivity of Loose-Fill Cellulosic Insulation Determined with a Heat-Flow-Meter Apparatus," Thermal Conductivity 24, Editors: Peter S. Gaal and Daniela E. Apostolescu, Technomic Publishing Company (1999) pp. 472-482 (with R. S. Graves).

"Physical Properties of Polyurethane Foam Containing Fine Powders Produced from Plastic Scrap Using a Mechanical Process," Thermal Conductivity 24, Editors: Peter S. Gaal and Daniela E. Apostolescu, Technomic Publishing Company (1999) pp. 483-495 (with F. Shutov).

### **1998**

"The Use of Low Emittance Surfaces for Residential and Industrial Insulation," Presentation to the Engineering Section of the Tennessee Academy of Science, November 20, 1998.

"Economic and Environmental Benefits of Industrial Insulation" - Keynote Presentation Symposium on Energy and the Environment, September 1-4, 1998. The University of the West Indies, St. Augustine, Trinidad.

"Development of a Physical Properties Data Base and Test Methods for Cellulosic Insulation," Oak Ridge National Laboratory, Oak Ridge, TN, C/ORNL 92-0147 (June 1998) (with K. E. Wilkes and R. S. Graves).

"Materials Research Associated with Thermal Insulations," First International Congress for Students of Engineering, University of Honduras, Tegucigalpa, Honduras, May 7-9, 1998 (invited).

"Expectations of Future Engineering Graduates," First International Congress for Students of Engineering, University of Honduras, Tegucigalpa, Honduras, May 7-9, 1998 (Invited)

"Status of Cellulose Insulation Fire Retardant Studies," Twenty-Fifth International Conference on Fire Safety, Millbrae, CA, January 12-19, 1998.

### **1997**

"A Variability Study on the ASTM Thin Slicing and Scaling Test Method for Evaluating the Long-Term Performance of an Extruded Polystyrene Foam Blown with HCFC-142b." Insulation Materials Testing and Applications, ASTM STP 1320, Edited by R. S. Graves and R. R. Zarr (1997) pp. 197-215.

"Heating and Cooling Loads for Single-Wide Manufactured Homes in Middle Tennessee," Presentation to the Engineering Section of the Tennessee Academy of Science, November 21, 1997 (with Gregory J. Andrews).

"Influence of Internal Cell Gas Pressure on the Aged Cell Gas Pressure Profiles," 24th International Thermal Conductivity Conference, Pittsburgh, PA, October 26-29, 1997 to be part of the Proceedings of the Conference (with J. Richard Booth and Phaneendra B. Kondapi).

"The Effect of Compression on the Apparent Thermal Conductivity of Loose-Fill Cellulosic Insulation Determined with a Heat-Flow-Meter Apparatus," 24th International Thermal Conductivity Conference, Pittsburgh, PA, October 26-29, 1997 to be part of the Proceedings of the Conference (with R. S. Graves).

## BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)

Page 7

"Physical Properties of Polyurethane Foam Containing Fine Powders Produced from Plastic Scrap Using a Mechanical Process," 24th International Thermal Conductivity Conference, Pittsburgh, PA, October 26-29, 1997 to be part of the Proceedings of the Conference (with Fyodor Shutov).

"Energy and Global Warming Impacts of Building Foam Insulation: TEWI Phase 3," ORNL/TM, Oak Ridge National Laboratory, August, 1997 (with Jan Kosny and Jeffrey E. Christian).

"A Study of the Effect of Compression on Measured Thermal Resistivities of Loose-Fill Cellulosic Insulation," Third Symposium on Insulation Materials: Testing and Applications, Quebec City, Quebec, Canada, May 15-17, 1997 with R. S. Graves and K. E. Wilkes.

"Insulation Design: Faster and a Lot More Exact," Chemical Engineering 104 66-72 (1997) with Lawrence L. Ambs, Stephen G. Braun, William P. Goss, Joseph Power, and Kenneth E. Wilkes.

"Thermal Design Considerations for Steel Frame Construction," 1997 ArkXSeal/BIBCA Convention, South Padre Island, Texas, February 13-15, 1997.

"Ignition Temperatures for Cellulosic Insulations," The 23rd International Conference on Fire Safety, Millbrae, CA, January 13-17, 1997 (with C. K. Chua).

### 1996

"Design of Improved Flammability Tests for Cellulosic Insulations," Proceedings of the International Conference on Fire Safety 22 30-49 (1996).

"Thermal Properties and Use of Cellulosic Insulation Produced from Recycled Paper," Conference on Use of Recycled Wood and Paper in Building Applications, Madison, Wisconsin (September 9-11, 1996).

"Major Types of Thermal Insulation Used in Buildings and Their Physical Properties," Oglethorpe Power Company, Tucker, Georgia (September 19, 1996).

"Effectiveness of Radiation Control Coatings for the Reduction of Building Solar Gain and Exterior Surface Temperatures," Cairo Fifth International Conference on Energy and Environment, Cairo, Egypt, June 3-6, 1996.

"Effectiveness of Reflective Roof Coatings," Journal of the Tennessee Academy of Science 71 16 (1996).

"Effective Diffusion Coefficients for CFC-11 by Gravimetric Depletion from Thin Slices of PIR Foam," Thermal Conductivity 23 325-337 (1996).

### 1995

"Modeling and Use of a Radiant-Heat-Flow Apparatus for Intermediate and High Temperature Thermal Conductivity Measurements," SAE Technical Paper Series 950614.

"Evacuated Superinsulations," Proceedings of Thermal Performance of the Exterior Envelopes of Buildings VI, pg. 649, Clearwater Beach, FL, December 4-8, 1995.

"Cellulosic Insulation in the 90's," Proceedings of Thermal Performance of the Exterior Envelopes of Buildings VI, pg. 651, Clearwater Beach, FL, December 4-8, 1995 (with R. S. Graves).

## BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)

Page 8

"Development of Evacuated Superinsulations," Proceedings of the November 1995 BETEC Meeting, Washington, D.C. (with K. E. Wilkes).

"Aging and Long-Term Thermal Values of HCFC Foams," Workshop at Polyurethane 1995, Chicago, IL, September 1995 (with J. R. Booth and R. S. Graves).

"Application of Scaling Techniques," SPI workshop on Technique for Determining Long-Term Thermal Performance by Slicing, Polyurethanes 1995 Conference, Chicago, IL, September 26-29, 1995.

"Aging of Thin-Slices of PIR Foams Manufactured with Alternative Blowing Agents," Journal of Thermal Insulation and Building Envelopes, 19:118-131 (1995) (with R. S. Graves).

"Evaluation of Radiation Control Coatings for Buildings," Proceedings of the Eleventh International Conference on Thermal Insulations, Millbrae, CA, March 13-14, 1995, pgs. 1-5 (with P. J. Dycus).

"Drying of Cellulosic Insulation," Proceedings of the Eleventh International Conference on Thermal Insulations, Millbrae, CA, March 13-14, 1995, pgs. 24-31.

"Thermal Insulation Research and Development in the 90's," Proceedings of the Eleventh International Conference on Thermal Insulation, Millbrae, CA, March 13-14, 1995, p. 32.

"Interlaboratory Comparison on Estimating the Long-Term Thermal Resistance of Unfaced, Rigid, Closed-Cell, Polyisocyanurate (PIR) Foam Insulation -- A Cooperative Industry/Government Project," ORNL/M-3976, Oak Ridge National Laboratory, January 1995 (with R. S. Graves, D. L. McElroy, and F. J. Weaver).

### 1994

"Evaluation of Radiation-Control Coatings for Buildings," Tennessee Academy of Science, November 17-18, 1994 (with Patricia J. Dycus).

"Solar Reflectance Measurements for Twenty Custom-Blended Radiation Control Coatings," Cool Building and Paving Materials Conference, NIST, Gaithersburg, MD, July 11-12, (1994).

"Superinsulated Refrigerator/Freezers: A Technology Characterization for the Department of Energy," ORNL/M-3652, Oak Ridge National Laboratory, Oak Ridge, TN (1994) (with T. G. Kollie and H. A. Fine).

"Calculated Heat-Flow Rates for Air-Handling Ducts Containing Bubble-Pack Reflective Insulation," Proceedings of the Tenth International Conference on Thermal Insulation, Vol. 10, pp. 23-31, Millbrae, CA, March 28-30, 1994 (with P. J. Dycus).

"Analysis of Composition Variation with Time for U.S. Borax Field Study," Proceedings of the International Conference on Thermal Insulation, Vol. 10, pp. 67-78, (1994) (with D. J. Ferm and K. K. Shen).

"Thermal Testing of Pipe Insulation Using AC Power and No End Guards," Proceedings of the Tenth International Conference on Thermal Insulation, Vol. 10, pp. 10-22, Millbrae, CA, March 28-30, 1994 (with J. Wartono).

"Properties and Applications of Powder-Filled Evacuated-Panel Superinsulations," Sixth AIAA/ASME Thermophysics and Heat Transfer Conference, Colorado Springs, CO, HTD-Vol. 271, (June 20-23, 1994) (with T. G. Kollie).

## BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)

Page 9

"Calibration of Transducer Arrays in Conjunction with ASTM C 518," Workshop on Heat Flow Meter Calibration, ASTM C 16, Williamsburg, VA, April 10, 1994. (with R. S. Graves).

"On-Site Reduction of Thermal Insulation Scrap for Use as Loose-Fill Building Insulation," Proceedings of the 10th International Conference on Thermal Insulation, Millbrae, CA, Vol. 10, pp. 1-9, (March 28-30, 1994) (with D. K. Smith).

"Building Thermal Insulation Technology," Dynamic Design Conference, Bozeman, Montana, March 3-4, 1994.

### 1993

"The Use of an Array of Heat Flux Transducers to Study Thermal Property Variations," Journal of Thermal Insulation and Building Envelopes 17 171-181 (1993) (with R. S. Graves).

"Thermal Conductivities, Electrical Resistivities, and Seebeck Coefficients of  $\text{YBa}_2\text{Cu}_3\text{O}_{7-x}$  Superconductors from 80-300K, 22nd International Thermal Conductivity Conference, Tempe, AZ, November 7-10, 1993. Thermal Conductivity 22, Editor: Timothy W. Tong, Technomic Publishing Company, Lancaster, PA (1994) pp. 554-563 (with R. W. Williams and D. Shockley).

"Use of Radiation Control Coatings to Reduce Ceiling Heat Flux in Hot Climates," 103rd Meeting of the Tennessee Academy of Science, Memphis, TN, November 19, 1993 (with R. Nachimuthu).

"Liquid-Liquid Distribution Coefficients and Mass Transfer of Chromium from Wastewater to an Organic Phase Containing an Amine," Eighth Symposium on Separation Science and Technology, Gatlinburg, TN, October 24-28 (1993). (with Jorge Destephen)

"The Use of an Array of Heat Flux Transducers to Study Thermal Property Variations," Proceedings of the 3rd International Workshop on Long-Term Performance of Cellular Plastics, October 4-6, 1993, Toronto, Canada (with R. S. Graves).

"Slicing and Testing of Foamboard Insulations," Poster Presentation, 3rd International Workshop on Long-Term Performance of Cellular Plastics, October 4-6, 1993, Toronto, Canada (with R. S. Graves and T. G. Kollie).

"Factors that Affect the Aging of Foam Insulations," Vanderbilt University, Chemical Engineering Seminar, January 15, 1993.

"The Performance of New Generation Cellulosic Insulations at Low Temperatures," Proceedings of the International Conference on Thermal Insulations 2 1-9 (1993) with S. Wudhapitak.

"Aging of Thin Slices of PIR Foams Manufactured with Alternative Blowing Agents," Second International Conference on Cellular Polymers, Edinburgh, Scotland, March 23-25 (1993). (with Richard Booth)

"Permanency of Chemical Fire Retardants Used in Cellulosic Insulation," Proceedings of the International Conference on Thermal Insulations 2 87-93 (1993).

"Use of Radiation Control Coatings to Reduce Building Air-Conditioning Loads," Energy Sources 15 59-66 (1993) (with Robert W. Anderson).

## BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)

Page 10

"Factors that Affect Thermal Performance of Buildings and Level of Comfort," Workshop on Thermal Performance of Building Envelopes, Universidad Autonoma de Baja California, Mexicali, Mexico, January 20-23, 1993.

"Computer Simulation of Energy Use in Residential Buildings," Workshop on Thermal Performance of Building Envelopes, Universidad Autonoma de Baja California, Mexicali, Mexico, January 20-23, 1993.

### 1992

"A Review of Research on the Permanency of Chemical Fire Retardant Chemicals Contained in Cellulosic Insulation," Thermal Performance of the Exterior Envelope of Buildings-V, Clearwater, FL, December 7-10, 1992.

"The Technical Viability of Alternative Blowing Agents in Polyisocyanurate Roof Insulation," ORNL/M-2480, Oak Ridge National Laboratory, December 1992 (with J. E. Christian et al).

"Laboratory Test Results on the Thermal Resistance of Polyisocyanurate Foamboard Insulation Blown with CFC-11," ORNL/M-2387, Oak Ridge National Laboratory, October 1992 (with R. S. Graves, D. L. McElroy, and F. J. Weaver).

"The Development of Superinsulations for Appliances," Engineering Section of the 102nd Meeting of the Tennessee Academy of Science, Austin Peay State University, Clarksville, TN, November 20, 1992.

"Literature Review: Heat Transfer through Two-Phase Insulation Systems Consisting of Powders in a Continuous Gas Phase," ORNL/M-2426, Oak Ridge National Laboratory, December, 1992. (Also EPA-600/R-92-903)

"Factors Affecting the Thermal Aging of Foams," 1992 Gordon Research Conference, Plymouth State College, Plymouth, NH, August 3-7, 1992 (with M. T. Bomberg).

"Distribution Coefficients for  $\text{Cr}^{+6}$  for an Aqueous Phase in Equilibrium with an Organic Phase Containing a Tertiary Amine," Paper 44b, 1992 Annual Meeting of the American Institute of Chemical Engineers, Miami Beach, FL, November 1-6, 1992 (with Jorge Destephen).

"A Thermal Resistance (R-Value) Correlation for Blow-in-Blanket Mineral Fiber Insulation," Journal of Thermal Insulation October, 1992 (with Clay C. Bare).

"Air Permeability of Loose-Fill Residential Insulations," Eighth International Conference on Thermal Insulation, Millbrae, CA, March 9-11 (1992) (with S. Wudhapitak).

"The Effect of Compression on the Material R-Value of Fiberglass Batt Insulation," Journal of Thermal Insulation 15 248-260 (1992).

### 1991

"Applied Research: Part of Undergraduate Education," Annual Meeting of the AIChE, Fall 1991, Los Angeles, CA (with J. D. Smith).

"Aging of Foamboard Insulation Containing CFCs or HCFCs," Engineering Section of the 101st Meeting of the Tennessee Academy of Science, Murfreesboro, TN, November 22, 1991.

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"Prediction of the Thermal Performance of Single and Multi-Airspace Reflective Insulation Materials," Insulation Materials: Testing and Applications, 2nd Volume, ASTM STP 1116, R.S. Graves and D.C. Wysocki, Eds., American Society for Testing and Materials, Philadelphia, 1991. (with A. O. Desjarlais).

"A Survey of Loose-Fill Insulations Installed in Residential Attics," Insulation Materials: Testing and Applications, 2nd Volume, ASTM STP 1116, R. S. Graves and D. C. Wysocki, Eds., American Society for Testing and Materials, Philadelphia, 1991. (with R. A. Penney).

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"Thermal Properties of Selected Materials from Steady-State and Transient Tests," Insulation Materials: Testing and Applications, 2nd Volume, ASTM STP 1116, R. S. Graves and D. C. Wysocki, Eds., American Society for Testing and Materials, Philadelphia, 1991. (with R. S. Graves, D. L. McElroy, and H. A. Fine).

"Preliminary Assessment of Radiation Control Coatings for Buildings," Insulation Materials: Testing and Applications, 2nd Volume, ASTM STP 1116, R. S. Graves and D. C. Wysocki, Eds., American Society for Testing and Materials, Philadelphia, 1991. (with R. W. Anderson, R. S. Graves, and R. L. Wendt).

"The Use of Liquid-Liquid Extraction for the Removal of Chromium from Industrial Wastewater," 1991 Summer National Meeting of the American Institute of Chemical Engineers, Pittsburgh, PA, Paper No. 16C (with Roger D. Painter).

"Reflective Insulation, Radiant Barriers, and Radiation Control Coatings," Tenth Annual Pennsylvania Frame Builders Conference, Pennsylvania State University, March 5-6, 1991 (with Cory Groft).

"A Thermal Resistance (R-Value) Correlation for Blow-in-Blanket Fiberglass Insulation," Proceedings of the Seventh International Conference on Thermal Insulation, Pages 8-15, March 25-27, 1991, Millbrae, California (with Clay C. Bare).

### 1990

"Monte Carlo Simulations of Sieving through NonWoven Media," Paper Number 276d, AIChE Annual Meeting, Chicago, IL, Nov. 11-16, 1990. (with David M. Cecala and Kyung-Ju Choi).

"Laboratory Test Results on the Thermal Resistance of Polyisocyanurate Foam Board Insulation Blown with CFC-11 Substitutes - A Cooperative Industry/Government Project," ORNL/TM-11645,

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Oak Ridge National Laboratory, December, 1990. (with D.L. McElroy, R.S. Graves, and F.J. Weaver).

"Acceleration of Thermal Resistance Aging Using Thin Boards," 33rd Annual Polyurethane Conference, Sept 30-Oct 3, 1990, Orlando, Florida. (with D.L. McElroy, R.S. Graves, and F.J. Weaver).

"Reflective Insulation Products - A Natural for Some Metal Building Projects," METAL ARCHITECTURE Oct. 1990. pgs 11-14.

"Permanency of Boric Acid used as a Fire Retardant in Cellulosic Insulation," Energy and Buildings 14 351-361 (1990) with N. Chiou.

"Design of Solvent Extraction Equipment for Removal of Heavy Metals from Wastewater," 100th Meeting of the Tennessee Academy of Science, November 16, 1990, Chattanooga, TN (with Roger D. Painter).

"Chemical Migration from Injection Wells," 100th Meeting of the Tennessee Academy of Science, November 16, 1990, Chattanooga, TN (with Sidney W. Jones).

"Estimation of the Thermal Resistance of a Series of Reflective Air Spaces Bounded by Parallel Low Emittance Surfaces," Conf. on Fire Safety and Thermal Insulations, Nov. 5-6, 1990, St. Petersburg, Florida, Proceedings edited by S.A. Siddiqui.

"The Effect of Compression on the Material R-Values of Fiberglass Batt Insulation," Conf. on Fire Safety and Thermal Insulation, Nov. 5-6, 1990, St. Petersburg, Florida, Proceedings edited by S.A. Siddiqui. (with R.S. Graves).

"Steady-State and Transient Tests Using the Unguarded Thin-Heater Transient-Test Method (Thermophysical Properties of Building Materials)," ORNL/TM-11629, Oak Ridge National Laboratory, Dec 1990 (with D.L. McElroy, R.S. Graves, and H.A. Fine).

"The Technical Viability of Alternative Blowing Agents in Polyisocyanurate Roof Insulation," Polyurethanes '90 Conference, Orlando, Florida, October 1-4, 1990 (with D. L. McElroy, R. S. Graves, and F. J. Weaver).

"The Thermal Performance of Closed-Cell Foamboard Insulation Containing a Gas Other than Air," 40th Canadian Chemical Engineering Conference, Halifax, N.S., July 15-21, 1990 (with R. S. Graves) Paper Number 344 EN-A08.

"ORNL Slab-on-Grade Edge Insulation Experiment Design, Construction, and Research Plan," ORNL/CON-280, 1990, (with J. E. Christian, K. W. Childs, P. W. Childs, R. S. Graves, D. L. McElroy, and D. Wasserman).

"Thermal Performance of a Closed-Cell Foamboard Insulation Containing HCFC-22," Sixth International Conference of Thermal Insulations, Millbrae, CA. (Feb. 12-14, 1990) with Ronald S. Graves, J.E. Christian, and Mario R. Destephen.

"The Thermal Resistance of Spray-applied Cellulosic Insulation as a Function of Density and Temperature," Sixth International Conference on Thermal Insulation, Millbrae, CA. (Feb. 12-14, 1990) with K.E. Depew and S. Rashid.

"Determination of a Friction Factor and Permeability of Nonwoven Material," American Filtration Society, Washington, DC (March 19-22, 1990) with D. Cecala and K.J. Choi.



## BIOGRAPHICAL SKETCH - David W. Yarbrough (continued)

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"Three Research Areas Associated with Thermal Insulation Used in Residential Attics," Southeastern Section of the American Society for Engineering Education, Charlotte, NC (April 8-10, 1990) with M. Said and Mario R. Destephen.

### 1989

"Heat Flow through Fibrous Insulation Heated from Below," Ninety-ninth Meeting of the Tennessee Academy of Science. Nashville, TN, November 17, 1989 (with S. Wudhapitak).

"Effects of Dust on Horizontal Radiant Barrier Performance," Sixth Annual Symposium on Improving Building Systems in Hot and Humid Climates, Dallas, TX, October 3-4, 1989 (with K.E. Wilkes and J.C. Cook, Jr.)

"Effective Uses of Reflective Foils and Radiant Barriers," Annual Meeting of the Insulation Contractors Association of America, San Francisco, CA, September 28, 1989.

"Contamination of Reflective Foils in Horizontal Applications and the Effects on Thermal Performance," ASHRAE Transactions 95 (2) (1989). (with J.C. Cook, Jr., and K.E. Wilkes).

"The Thermophysical Properties of Gypsum Boards Containing Wax," 21st International Thermal Conductivity Conference, Lexington, KY, October 15-18, 1989. (with R.S. Graves, D.L. McElroy, and H.A. Fine).

"Absorption and Desorption of Vapor Phase Organic Chemicals by Cellulosic Insulation," Proceedings of the Second California Thermal Insulation Conference, Sacramento, CA, September 18-20, 1989 pgs 34-42 (with P.L. Bhatt).

"Testing of Loose-Fill Cellulosic Insulation Taken from Residential Attics in Four Cities," Proceedings of the Second California Thermal Insulation Conference, Sacramento, CA, September 18-20, 1989 pgs. 86-9? (with R.S. Graves).

"The Thermal Resistance of Flat Powder-Filled Evacuated Panels," Fifth International Conference on Thermal Insulation, San Francisco, CA, February 27-March 1, 1989 (with R.S. Graves and D.L. McElroy).

"Moisture Transport in Oriented Strand Board with Foil Bonded to One Face," Technical Report to Weyerhaeuser, January 1989 (with E.S. Percell).

"An Experimental Study of Stabilized Cellulosic Insulation Installed in Four Sections of Manufactured Homes," ORNL/TM-10775, January 1989 (with R.S. Graves).

"Thermal Radiant Barriers," Paper No. 89-251, Southeast Region Meeting, American Society of Agricultural Engineers, Nashville, TN, February 6, 1989.

"Sublimation of Boric Acid from Cellulosic Insulation," Fifth International Conference on Thermal Insulations, San Francisco, CA, February 27-March 1, 1989 (with N. Chiou).

### 1988

"Modeling Heat Generation and Flow in the Advanced Neutron Source Corrosion Test Loop Specimen," ORNL/TM-10603, Oak Ridge National Laboratory, 1988 (with R.E. Pawel).

"The Thermal Resistance of Spray-Applied Fiber Insulations," Journal of Thermal Insulation, 11 81-95 (October, 1987) with R.S. Graves, D.L. McElroy, A.O. Desjarlais and R.P. Tye.

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"Thermal Resistance of Wall Cavities Containing Reflective Insulation," ORNL/SUB-7715/6, Oak Ridge National Laboratory Report (1988) with Byung J. Han.

"Survey of Lithium Properties," Fifth Symposium on Space Nuclear Power Systems, Albuquerque, NM, (February, 1988) with R.K. Williams and G.L. Coleman.

"Testing Thermal Insulations with a Thin-Heater Apparatus," Building Thermal Envelope Technology Series I 59-86 (1988), with D.L. McElroy and R.S. Graves. Fifth meeting of the Building Thermal Envelope Materials Committee, Washington, D.C. (January 7, 1987).

"The Thickness and Density of Loose-Fill Insulations after Installations in Residential Attics," ASTM STP 922, F.J. Powell and S.L. Matthews, Ed., American Society for Testing and Materials, Philadelphia, 1987, pp. 492-505 with David L. McElroy and Ronald S. Graves (paper presented in 1984).

"Transient Conductive and Radiative Heat Transfer Through a Porous Layer with One Boundary Subject to a Time Varying Temperature Condition," Thermal Conductivity 19 edited by David W. Yarbrough, Plenum Press (1988) pages 467-479. From the 19th International Thermal Conductivity Conference, Cookeville, TN (October 20-23, 1985), with T.W. Tong, Y.M. Hou, and D.L. McElroy.

"Moisture Transport in Oriented Strand Board," Ninety-eighth Meeting of the Tennessee Academy of Science, Tennessee Technological University (November 18, 1988), with E.S. Percell.

"Analysis of Heat Flow through Dynamic Insulation," Proceedings of the First California Thermal Insulation Conference, Ed. S.A. Siddiqui, Bureau of Home Furnishings and Thermal Insulation (1988) pgs. 128-144. (with C. Lin).

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### 1987

"The Thermal Resistance of Advanced Insulation Candidates for Building Equipment,," ASHRAE Annual meeting, Nashville, TN. (June 30, 1987) with D.L. McElroy, R.S. Graves, and F.J. Weaver.

"Thermal Conductivities of Low Density Perlite Concretes Obtained with a Radial-Heat-Flow Apparatus," 20th International Thermal Conductivity Conference, October 19-21, 1987. VPI & SU, Blacksburg, VA (with R.D. Haynes).

"Thermal Conductivity of Beds of Spheres," 20th International Thermal Conductivity Conference, October 19-21, 1987. VPI & SU, Blacksburg, VA (with D.L. McElroy, F.J. Weaver, M.J. Shapiro, and A.W. Longest).

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"Thickness and Density Measurements for Attic Loose-Fill Thermal Insulations in Eight Cities," ORNL/TM-10414, Oak Ridge National Laboratory, August 1987 (with R.S. Graves, and D.L. McElroy).

"Effect of Point Defects on the Phonon Thermal Conductivity of bcc Iron," Journal of Applied Physics, 62 (7) 2778-2783 (October 1, 1987) with R.K. Williams, R.S. Graves, and F.J. Weaver.

"Chemical Engineering and the Development of Materials for Energy Conservation," 17th National Meeting of the Mexican Institute of Chemical Engineers, October 21-23, 1987, Ixtapa, Mexico (Invited talk).

"Modeling of Thermal Resistance Test Configurations That Use Thin Heaters," Symposium on Insulation Materials, Testing, and Applications (ASTM/DOE), December 6-11, 1987, Bal Harbour, FL (with D.L. McElroy, and R.S. Graves).

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"Thermal Conductivity of Oxide Ceramics," 25th Automotive Technology Development Contractor's Coordination Meeting, October 26-29, 1987 Dearborn, Michigan with R.K. Williams and R.S. Graves.

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"Fire Retardants in Cellulosic Insulation," Journal of Thermal Insulation 10 219-224 (1987) with N. Chiou.

"The Effects of  $\text{Cr}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  Additives on the Thermal Conductivity of  $\text{Al}_2\text{O}_3$ ," Journal of Applied Physics (May 1, 1987) with R.K. Williams, R.S. Graves, M.A. Janney, and T.N. Tieg.

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"The Thermal Resistance of Perlite-Based Evacuated Insulations for Refrigerators," ORNL/CON-215, with R.S. Graves, F.J. Weaver, and D.L. McElroy, Oak Ridge National Laboratory, September (1986).

"Thermal Resistance of Wall Cavities Containing Reflective Insulation," Journal of Solar Energy Engineering 108 338-341, with B.J. Han and S.M. Han.

"The Engineering Section of the Tennessee Academy of Science from 1955 to 1986," 96th Meeting of the Tennessee Academy of Science, Nashville, TN, (November 21, 1986) with James X. Corgan.

"Analysis of Transient Heat Transfer Measurements on Porous Thermal Insulation," The Eighth International Heat Transfer Conference and Exhibition, San Francisco, California, August 17-22, 1986, with T.W. Tong and D.L. McElroy.

"Status of ASTM Reflective Insulation and Radiant Barrier Standards," TVA/ORNL Technical Workshop on Radiant Barriers, Chattanooga, TN, May 21, 1986.

"Development of Advanced Thermal Insulations for Appliances," ORNL/CON-199, Oak Ridge National Laboratory, April (1986) with F.J. Weaver, R.S. Graves, and D.L. McElroy.

"Thicknesses, Densities and Calculated Thermal Resistances for Loose-Fill Rock Wool Installed in Two Attic Sections of a Manufactured House," ORNL/TM-9927, Oak Ridge National Laboratory, March 1986 (with R.S. Graves).

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"Apparent Thermal Conductivity Measurements by an Unguarded Technique," Journal of Thermal Insulation 9 123-139 (1985) (with R.S. Graves and D.L. McElroy) (presented at 18th International Thermal Conductivity Conference, October 3-5, 1983, Rapid City, SD and published in Thermal Conductivity 18, Plenum Publishing Company) 339-355.

"Use of Low Density Concrete for Energy Conservation," Proceedings of the 7th Miami International Conference on Alternative Energy Sources, Miami Beach, FL, December 9-11, 1985 (with Ntoria K. Michael and Robert D. Haynes).

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"Research Review and Strategy for Evaluation of High Thermal Mass Building Envelope Components," 36th Annual Meeting of the Perlite Institute, Cancun, Mexico, May 5-10 (1985).

"Prediction of Vapor-Liquid Equilibrium Data for Two-Component Mixtures from Heats of Mixing and the Complete Local Concentration Model," 4th International Chemical Engineering Conference, Coimbra, Portugal, April 15-19, 1985, with Nan Chiou.

"Analysis of Transient Thermal Measurements on Fibrous Insulations Obtained with an Unguarded Flat Tester," 4th International Chemical Engineering Conference, Coimbra, Portugal, April 15-19, 1985 (with D.L. McElroy, T.W. Tong, and J.K. Wood III).

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#### 1984

"Transient Conduction and Radiation heat Transfer in Porous Thermal Insulations," American Society of Mechanical Engineers Winter Meeting, New Orleans, LA (December 9-14, 1984) with T.W. Tong and D.L. McElroy.

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"Prediction of Vapor-Liquid Equilibrium Data from Heats of Mixing," Engineering Section of the 94th Meeting of the Tennessee Academy of Science, University of Tennessee - Knoxville, November 16-17, 1984 (with Nan Chiou).

"Low Density Concrete as a Thermal Insulation," Engineering Division of the 94th Meeting of the Tennessee Academy of Science, University of Tennessee - Knoxville, November 16-17, 1984.

"Vibration of Mineral Fiber Loose-Fill Insulation at 15 Hertz and Displacements of 0.004 inch and 0.025 inch," A.S.T.M. C-16 Meeting, Minneapolis, MN, October 14-17, 1984 (with V. Ebolum).

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"Storage of Radioactive Waste in Glass," Miami International Symposium on the Biosphere, Miami Beach, Florida, April 23-25, 1984.

"Preliminary Analysis of Thickness and Density Observations on Loose-Fill Mineral Fiber Insulation in Bucyrus, Ohio, Seattle, Washington, and Columbia, Tennessee," ASTM C-16, San Antonio, TX, April 22-26, 1984 (with R.S. Graves and D.L. McElroy).

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"Aluminum Foils for Building Thermal Insulation," 93rd Meeting of the Tennessee Academy of Science, November 18-19, 1983.

"Assessment of Reflective Insulations for Residential and Commercial Applications," ORNL-TM-8891, Oak Ridge National Laboratory, October, 1983.

"Interim Report on Attic Field Test of Loose-Fill Cellulosic Insulation," American Society for Testing and Materials, C-16 Meeting, Philadelphia, September 19-21, 1983 with D.L. McElroy and R.S. Graves.

"Liquid Phase Activity Coefficients for Solutions of Allyl Alcohol, Propanol-2, and Methanol Determined from Total Pressure Measurements," AIChE National Meeting, March 27-31, 1983. Houston, Texas (with K. Dema).

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"Thermal Resistance of Reflective Foil Insulations Installed in a Simulated Wall Cavity," , Proceedings of the ASHRAE/DOE Conference on Thermal Performance of the Exterior Envelopes of Buildings II, December 6-9, 1982, Las Vegas, NV (with S.G. Kim).

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"Properties and Testing of Loose-Fill Cellulosic Insulation," Oak Ridge National Laboratory ORNL/TM-6433 February, 1982 (with D.L. McElroy and W.W. Harris).

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